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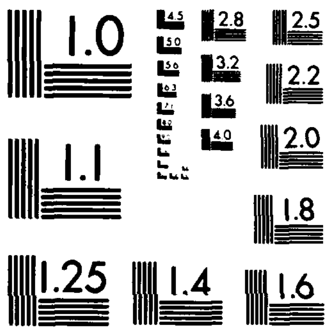
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ONR LONDON REPORT

R-7-83

AD A133093

OFFICE OF NAVAL RESEARCH

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ENGLAND

APPLIED PSYCHOLOGY IN EUROPE:
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N.A. BOND, JR.

27 JULY 1983

UNITED STATES OF AMERICA

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER R-7-83 — 2. GOVT ACCESSION NO. AD A133093	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Applied Psychology in Europe: An ONR Perspective	5. TYPE OF REPORT & PERIOD COVERED Assessment 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) N.A. Bond, Jr.	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Office of Naval Research, Branch Office London, Box 39, FPO NY 09510	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE 27 July 83 13. NUMBER OF PAGES 7
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Applied psychology	Digital simulators
Man-machine interfaces	Performance models
Combat reactions	Memory enhancement

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is intended to alert American researchers to European developments in applied psychology. The following areas are examined: interactive man-machine interfaces, combat reactions and stress, memory enhancement, large digital simulators, and human performance models.

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S/N 0102-LF-014-6601

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EXECUTIVE SUMMARY

The scale of European effort in applied psychology is only a fraction of that found in the US. However, some European work is at or near the edge of the art, and the material has immediate or potential significance to the Navy research program. Five areas of research, and the principal European sources of information, are reviewed briefly here.

1. Truly interactive man-machine interfaces. In existing man-machine displays involving the analysis of complex processes, the human operator works at a terminal. He can select and eliminate data sets, can remove noise with light pens or special subroutines, can cause various operations to be done on the data and then displayed, can "magnify" portions of the material for detailed scrutiny, and can exclude all but the "most critical" elements from the screen. The next breakthrough will come when humans can alter the signal-processing algorithms themselves in order to reflect human knowledge, hunches, and awareness of immediately prevailing conditions. European pattern recognition and semiautomated cancer-cell classification systems are approaching "true" interaction between man and computers. West Germany is probably the leading country. Sources: Ulm (AEG Telefunken), Univ. of Hamburg, and Univ. of Erlangen.

2. Combat reactions and stress. With major military military operations in 1982 by Israeli and British forces, fresh data are now being tabulated on matters such as "combat reaction" casualties, small group cohesion, morale, and heroism. There are remarkable similarities, and remarkable differences, between the Israeli-Lebanon results and those coming from the British-Falkland conflict. "Smart" weapons mean that warfare is more intensive; that specific small groups of personnel in headquarters, logistics, and communications centers can be pinpointed as targets; and that primary-group identification is critical. Much material is becoming available to ONR psychologists through the International Symposium on Applied Military Psychology and ordinary defense ministry liaison. It should be written up from the psychological point of view and correlated with "standard" sources of battle analysis. Sources: Ministries of defense in Britain and Israel.

3. Memory enhancement. Fairly consistent behavioral effects are being shown with vasopressin-like peptides in animals and humans. Administered by a nasal spray, the chemicals apparently improve the rate of information processing in some clinical groups. In animals, vasopressin seems to affect principally the consolidation and retrieval of information; the drug's effects are reduced or eliminated if relevant brain structures are lesioned. Since the work has potential clinical value with certain neuro-psychological classifications, it should be followed closely. The use of the Saul Sternberg model for scoring information rate in clinical patients is novel. Sources: Utrecht Univ. and Rudolf Magnus Institute for Pharmacology (Netherlands).

4. Large digital simulators. Important simulator projects are now running in Europe. Moderately realistic ground and ocean scenes can be computed on-line and displayed in color. Little waves and clouds appear; important ground features "grow" in a convincing fashion. Evaluations of the usefulness of the simulators for training are now under way. The image construction techniques seem to be quite similar in the big simulators; nobody knows whether slightly improved images, which shortly will be possible through faster computation, will be worth the additional cost and effort. Also, real time transformations of scenes from a fast-moving

aircraft are not really feasible yet. French and British simulators should be carefully compared with the American system now operating at Kings Point, and with the new simulator projects at NTEC, Orlando. There are important mathematical problems associated with representing three-dimensional ground features. Sources: Cardiff Ship Simulator (UK); Thomson-Sogitec (Boulogne, France); EASAMS Ltd. (Camberley, Surrey, England); Rediffusion Simulation (Crawley, Sussex RH10 2RL, England).

5. Human performance models. European modeling efforts are probably state of the art. The Dutch aerospace community has some of the most advanced models relating to fine-grained control and detection tasks. "Information per glimpse," for example, can be calculated from vehicle steering experiments. There is also significant continental work on the way that humans estimate the state of a dynamic linear system. If a non-zero mean system state occurs, then the human observer must recognize that there has been an innovation sequence. Very accurate predictions of human detection can be made by assuming that certain mathematical relations hold between the input process and the human decision. So far, these "validations" are on extremely narrow tasks, but they can be made more realistic.

Estimation of human "reliability numbers" or performance probabilities is under active investigation in England. A practical alternative to the Swain-Rock-Siegel method of probability summation may be at hand. Sources: Delft Univ.; the Netherlands Organization for Applied Scientific Research (TNO, P.O. Box 23, 3769 ZG Soesterberg, the Netherlands); the National Aerospace Laboratory (Netherlands); and the London School of Economics (UK).

APPLIED PSYCHOLOGY IN EUROPE: AN ONR PERSPECTIVE

This report is intended to alert American researchers to European developments in applied psychology. Some projects are worthy of attention and are not well publicized in the West.

Since May 1981 the writer has visited several dozen European universities, laboratories, institutes, and technical meetings. With so many competent people working in applied psychology, a great many interesting projects have been encountered, ranging from the selection of bomb-disposal squad members to computerized testing stations. This report singles out five specific areas of European research activity; the principal criteria for choosing them were as follows: (1) there are now one or more very active European programs in the area; (2) the scientific level of achievement is at or near the state of the art, or there are novel elements in the current work; and (3) the area has immediate or potential significance for the US Navy's research programs in the behavioral sciences.

Truly Interactive Man-Machine Systems

Compared with the stolid alphameric CRTs of 1970, today's computer terminals are marvelous devices. Full color and a great range of graphics capabilities are now available in even the cheapest terminals. Analysts who work at terminals on complex tasks also have a great range of options for using their systems. Displayed objects can be relocated, magnified, suppressed, or superimposed; there may be cursors, track balls, and light pens for "hooking" or designating items for special treatment. Through time-compression and quickening routines, the world can apparently be "run off" either in fast time or slow time, with an unlimited range of simulation processes. "What if" questions about system states under a range of conditions often can be explored almost instantly. One can buy "off the shelf" graphics packages that can call up many transformations and enhancement schemes for any given data set.

Much of the operator's skill in using such facilities, however, is in selecting a new mode or transform from the many options available. He cannot easily create new transformations of data. And if he inserts elements of his own experience, knowledge, and feelings into the machine, he usually must deal with constraints imposed by some unknown and long-gone programmer.

The fullest interaction between man and machine may exist when the man not only can select and control the machine's computations and manipulations, but also can alter the various "front-end" processing routines that are driving the display. For this interaction to occur, the human's input would have to be definite enough to be expressible in some systematic language, and the human operator would have to understand the processes behind the screen well enough to attempt useful modifications and manipulations. At the same time, the computer system would have to be able to incorporate new models and changes without crashing. Thus, there are new demands on both man and machine if the deepest kind of synthesis is to be achieved.

Semiautomated cytological screening programs, now being pursued in all the major European countries, may offer a fairly immediate prospect of achieving truly interactive systems. To take just one example, consider mass screening programs using Pap gynecological smears. Slide specimens from certain medical laboratories may have special characteristics which can be appreciated by a skilled person and are not easily perceived by an automatic system. Suppose that complex gray-level analyses are being done on cell nuclei, with many mathematical functions running on each of the discriminable cells in a picture, and that an expert operator is watching the early results from a run of slides. The operator may feel that for this particular batch of material the results do not "feel" quite right, or that they may not represent the latest qualitative knowledge about cell biology. Perhaps these human judgments are mistaken or erratic. But consider the possible improvement in output that could occur if the operator tries gray-level processing functions rather different from the ones the machine originally calculates. Possibilities for subsequent modification might occur as the operator changes functions and watches the effects of his changes and hunches on total system performance.

Among the major European investigators active in the area are J. Schürmann and R. Ott (AEG-Telefunken Research Institute, 7900 Ulm, West Germany) and the Reinhardt team in Stuttgart (Institute for Physical Electronics, Univ. of Stuttgart, 7000 Stuttgart, West Germany). A team in Munich has been comparing human and machine recognition of hand-printed alphameric characters, and has discovered some transformations that make machine performance comparable to human discrimination; work of this kind also could approach true interaction before long (R.D. Tilgner, Lehrstuhl für Nachrichtentechnick, Techn. Universität Munchen, 8 Munchen 2, West Germany). In Zurich, computer-aided schemes for recognizing an individual patient's patterns of EEG signals are among the most advanced in the world, and interactive analysis in the domain may soon be possible (H.H. Stassen, Psychiatric Univ. Clinic, Zurich). There are three major man-machine research facilities in Britain, all of which are doing man-machine interface work and getting closer to really complex interaction (Medical Research Council [MRC] Applied Psychology Unit, 15 Chaucer Road, Cambridge CB2 2EF; Leicester Polytechnic, P.O. Box 143, Leicester LE1 9BH; Loughborough Univ. of Technology, Loughborough LE11 3TU).

Psychology of Combat Reactions and Stress

In 1982, the Israelis and the British carried out major and successful military operations. A considerable body of material is now becoming available from these campaigns on the human aspects of modern combat. The material should be collated by psychologists, and interpretive reports probably should be prepared from the strictly psychological point of view. (American and Canadian military teams have issued excellent "lessons learned" reports on both the Lebanon and Falklands conflicts, but such reports often proceed from a traditional military standpoint and do not necessarily integrate the experiences into a comprehensive psychological model.)

Human-oriented official data on the Lebanon war are already being published, and with psychologist officers in all the Israeli services, the consistency of viewpoint is quite good. In June 1983, for example, Even-Chen of the Israeli armored forces reported data on the proportions of "combat reaction" casualties who were returned to full duty after various treatments; he also formulated a chain-reaction situational model of the events that lead to a combat-reaction withdrawal from battle. Other data from Israeli Navy files are also being reported in the open literature. One intriguing set of results relates to Army and Navy units that had heavy combat and still suffered no appreciable evacuations as a result of combat reactions. The human features of these remarkably "tough" units are now under intensive study and may yield nonintuitive results.

The open-literature Falklands evidence on human-factors variables is still spotty, but technical analyses are beginning to appear. For example, it is known that the Royal Marine contingent of more than a 1,000 men had only half a dozen psychiatric problems that were serious enough to demand official registration aboard the Canberra hospital ship. However, after the Falklands operation was nominally completed and the men returned home, some psychological problems occurred.

A relatively short summary of the data themselves and the published interpretations of them seems in order.

Sources: MAJ Moshe Even-Chen and LTCOL Naftali Hadas, Israeli Armoured Corps; Dr. Gail Esroni, Israeli Navy Psychology Unit; LTCR Surgeon R. O'Connell, Royal Navy Hospital, Gosport, England.

If American psychologists wrote a comprehensive summary report, the combat findings might contain some material that is rather antithetical to current American military views. For example, officer selection, training, and officer-crew relationships in the Israeli forces may differ drastically from US Navy practice. The integrity of a small primary military unit may depend on bonding processes; the Israelis believe that these may demand the abandonment of certain ceremonial practices and the adoption of very flexible doctrines for human social and operational interactions both on and off the battlefield. The recency of Israeli combat and the likelihood of "smart" weaponry and accurate targeting in future wars suggest that very careful attention should be paid to these interpretations.

Memory Enhancement

Maybe the term "memory enhancement" is too sensational, but it does seem reasonably clear that peptides related to vasopressin can have behavioral effects in laboratory animals and in humans. More than a decade ago, De Wied found that experimental rats lacking vasopressin showed decrements in learning and in the retention of certain behaviors; vasopressin "corrected" the deficiencies. From the early successes, systematic animal programs have been carried out; about six peptides with slightly differing amino-acid sequences have been investigated for their behavioral impact. The animal results were reliable enough to encourage some human trials, which started 4 or 5 years ago in the Netherlands.

The clinical data with humans are still quite limited and conflicting; they reflect many difficulties with classifying clinical patients, with the route of administration (intranasal spray or intramuscular hypodermic), with measurement of the effects, and with the interpretation of positive and negative effects. For example, the authorities in the field now believe that demonstrable positive effects are more likely to be observed in patients who exhibit relatively mild disorders of memory, senile dementia, or depression. If degenerative processes have proceeded beyond a certain level, then vasopressin (or indeed any other chemical) is unlikely to produce marked improvement. This still leaves a very large cohort of potential beneficiaries.

Psychologists should be interested in some preliminary methodological work that suggests the clinical usefulness of the Saul Sternberg experimental paradigm. Personal "rate of information processing" in searching a controlled domain apparently is a reliable measure in mild to moderately damaged patients, and it also seems to be a very sensitive indicator of vasopressin effects. Thus, a methodological breakthrough may be at hand for classifying patients and for assessing behavior change due to vasopressin-like substances. The Netherlands review of the reaction-time nature of "Sternberg parameters" seems to agree rather well with previous "rate thinking" data in brain-damaged patients. Such measures may indeed be more suitable than the usual etiological grouping criteria now used in neurology and psychiatry. Certainly application of Sternberg rate and intercept parameters in a clinical setting is novel.

The major European center for vasopressin studies is Utrecht; D. De Wied is the "grand old man" in the field, and J. Jolles is the psychologist who is developing the rate-of-processing technology and is evaluating the effectiveness of various peptides. Both investigators have joint appointments (Psychiatric Univ. Clinic and Rudolf Mangus Institute for Pharmacology, Nicholaas Beetsstraat 24, 3511 HG Utrecht, the Netherlands).

Large Digital Simulators

There are some half-dozen analog simulators in Europe that use physical models to represent terrain and harbor geography. Such simulators use a "toy" model of a town or harbor, perhaps at a scale of about 500 to 1. A TV camera is then "flown" over the scene by a control apparatus scaled to have the same equations of motion as a vehicle such as a ship or airplane. The TV picture presented to the human controller on such a simulator is quite realistic; and if the analog control scheme is well engineered, the setup can be very useful for research and training applications. But the drawbacks are obvious. Big barn-like structures are necessary to house the terrain models; there is no alternative to building a new "toy town or toy harbor" for representing new areas. Though illumination of the physical model can be varied, the basic "grain" of a display often cannot be systematically changed. Models differ in their degree of detail, in the qualitative terrain variance displayed, and in their local practices for running a training course. Every simulator has its own tricks and limitations, with much of the expertise residing in a few experienced technicians.

When the present generation of minicomputers appeared in the late 1970s, it was obvious that digital simulation was more feasible than ever, and that extreme flexibility might be achieved by clever programming. Buildings, mountains, harbors, and other terrain features could be standardized into a few classes. To "construct" a new town or geographic area, all that is necessary is to call up and locate subroutines for each of the standard terrain features. A town or harbor or island then exists as a computer program, and it is displayed on a video tube by a special operating system in the display driver. For large panoramic displays, the digitally derived video picture can be projected on a large screen by several integrated projectors.

At least three large digital simulators are now operating in Europe. The one at the Univ. of Wales Institute of Technology (Cardiff CF1 3NU, UK) can be taken as a prototype. It is used primarily for ship's bridge training and research, and it presents a large dynamic color display of harbor and ocean scenes. Both stationary and mobile features in the scene are made up of triangles; thus a distant lighthouse may consist of two or three "thin" adjacent triangles, and the representation is a simple outline only, perhaps filled in to be lighter or darker than the surroundings. As the simulated moving ship gets "closer" to the lighthouse, windows and color bands are represented, and more triangles must be drawn on the master video to show the additional detail. Clever assembly of triangles can produce nearly any feature; a fairly good representation of a helicopter taking off from a carrier is now on line at Cardiff. Rediffusion's "Lookout 3" can generate up to 2,500 "surfaces" in 256 smooth color shades.

Such digitally driven machines could make it easier to evaluate many psychological and administrative questions about simulators as trainers. For example, can the theoretical transfer-versus-realism curve postulated by Miller many years ago be confirmed? What are the psychometric and statistical properties of the different time-savings and transfer indexes that have been proposed? At what point does the crudeness of simulation become noticeable to trainees, and when does it begin to degrade performance? How can geographical and topographical data bases, say of a new harbor or a distant combat area, be quickly formulated and stored? Is a general system emerging for constructing a digital data base, say from the usual reference materials and from satellite data?

From the mathematical point of view, there are interesting issues in representing terrain efficiently, in calling it up and zeroing in on something of interest, and in modifying it when the real world changes, or when mission goals are shifted. French mathematicians reportedly are very active in the area. In England, some rather beautiful color displays of harbor area terrain can now be generated by perspective transformation of little squares on the ground, but the demands for general realism almost certainly will require more elaborate representations than such "perspective squares." Sources: EASAMS, Ltd., Camberley, Surrey, GU16 5EX, UK; various CNRS Laboratories in France; Rediffusion Simulation (Crawley, Sussex RH10 2RL, UK).

Performance Models

The classical "optimal controller" model of human behavior postulates that the human operator acts in a near-optimal manner, and the predictions from the model are often very close to actual behavior. Present European research in this tradition is extending the models to include environmental parameters (perception thresholds and delays, human noise, and immediate intentions and objectives). Attractive indexes of operator cognitive workload can be calculated with this approach; for instance, the Dutch National Aerospace Laboratory (NLR) has an effort measure of supervisory control. The measure is based on the sensitivity of the human's uncertainty about a task relative to the attention time devoted to that task. Source: R.C. Van de Graff, NLR, Amsterdam, the Netherlands.

Other Dutch workers have refined a "glimpse" technique for assessing rate of information gain in a continuous driving task. The driver has to activate a special head-mounted shutter in order to get a short look at the road. With the setup, it is even possible to correlate instantaneous heart rate changes with the information-seeking behavior; this realization is perhaps one of the "tightest" man-machine loops that has been achieved in the laboratory. Source: P. Milgram, NLR, Amsterdam, the Netherlands.

Some of the human operator modeling at Delft Univ. uses the "linear hydraulic motor" in an experimental setup. A very complete theoretical system for estimating proprioceptive and visual feedback has been investigated. Source: Wim Thijs, Delft Univ. of Technology, Laboratory for Measurement and Control, Department of Mechanical Engineering.

The "human reliability" models pioneered by Swain, Rock, and Siegel may soon be supplemented or superseded by some British research. The Swain approach is to break down job sequences into tiny bits of behavior; to assemble these, often by assuming numerical probabilities of success or failure; and to sum or multiply over the series of micro-tasks. Some years ago, Siegel applied the technique to carrier approach and landing, with aggregated probabilities resembling "real" likelihoods. London researchers are evaluating an "expert's panel" procedure that seems to attenuate some of the problems with the Swain method and is more acceptable to managers than the Swain probability aggregation. Trial applications have already been made, with early success. Source: L.D. Phillips and Patrick Humphreys, London School of Economics and Political Science, London WC2A 2AE, UK.

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